

# Properties of Logs

(P1)

$$Y = B^X \iff X = \log_B(Y)$$

log base b of y

"Solve for exponent"

Ex  $100 = 10^X$

(P1)

$$X = \log_{10}(100)$$

"get rid of a log"

Ex  $\log_3(X) = 2$

Base  $\begin{matrix} \nearrow 3 \\ \searrow 3 \end{matrix}$   $\begin{matrix} \text{(P1)} \\ \boxed{2} \end{matrix} = X$  ✓

(A) Algebra

$$9 = X$$

(P2) Sum/Product

$$\log_B M + \log_B N = \log_B (M \cdot N)$$

"combine logs" →

Ex  $\log_2 x + \log_2 7 = 3$   
(P2)

$$\log_2 (7x) = 3$$

(P1)

$$2^3 = 7x$$

(A)

$$8 = 7x$$

"Finding a component"  $8/7 = x$

Ex Given  $\log 1.1 = .0414$

Find  $\log 11000$

(A)

$$\log(1.1 \times 10^4)$$

(P2)

$$\log 1.1 + \log 10^4$$

$$.0414 + 4 = 4.0414$$

# (P3) "Ladder" Property

$$N \log_B A = \log_B A^N$$

$$\underbrace{\log x + \log x + \log x}_{10} \quad \text{(P2)}$$
$$\log x^{10}$$

$$10 \log x = \log x^{10}$$

Get rid of a coefficient" →

Ex  $10 \log_{10}(x)$  ~~10~~

(P3)

$$10 \log_{10} (x)^5$$

(INV)

$$x^5$$

Ex  $2 \log_{10} 3 + 5 \log_{10} 7$

(P3)

$$\log_{10} 3^2 + \log_{10} 7^5$$

(P2)

$$\log_{10} (3^2 \cdot 7^5)$$

"Get an exponent out of logs" ←

$$\log_3 27^{1000}$$

(P3)

$$1000 \cdot \log_3 27$$

(A)

$$1000 \log_3 3^3$$

(INV)

$$1000 \cdot 3$$

(AG)

3000

(P4) Change of Base

$$\log_A B = \frac{\log_x B}{\log_x A} = \frac{\log B}{\log A} = \frac{\ln B}{\ln A}$$

"change of the Base"

$$\text{EX } \log_3 27 = \ln(27) / \ln(3) = 3$$

"Simplify dividing logs"

$$\text{EX } \frac{\log_7(9)}{\log_7(6)} = \log_6(9)$$

○ (PS) Log of Both Sides

$$A = B \quad \log A = \log B$$

Take log of Both Sides →

$$y = e^x \quad \text{(PS)} \rightarrow \ln y = \ln e^x$$

$$\ln y = x$$

Drop log from both Sides ←

$$\log 3 = \log x \quad \text{(PS)} \quad 3 = x$$

INVERSES

$$y = B^x \quad \text{inverse} \quad y^{-1} = \log_B x$$

$$(f \circ f^{-1})(A) = (A)$$

$$(f^{-1} \circ f)(A) = (A)$$

$$(f \circ f^{-1})(x) = B^{\log_B x} = x$$

$$(f^{-1} \circ f)(x) = \log_B B^x = x$$

GROUP NAME:

Logo:

Date: \_\_\_\_\_

Topics:

Student Names (First and Last)

Speaker/Presenter: \_\_\_\_\_

Writer/Prep: \_\_\_\_\_

QC/Leader: \_\_\_\_\_

Instructions:

$\textcircled{PI}$  F

$$y = 3^x$$

$$y = \frac{1}{3^x}$$



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Writer/Prep: \_\_\_\_\_

QC/Leader: \_\_\_\_\_

Instructions:

$\pi$  R

$$\ln x = 3$$

$$e^3 = x$$

$$20.085 = x$$

<b>GROUP NAME:</b> 112 90	<b>Student Names (First and Last)</b>
<b>Logo:</b> [Handwritten]	<b>Speaker/Presenter:</b> <u>John Pe. King</u>
<b>Date:</b> <u>10/17</u>	<b>Writer/Prep:</b> <u>[Handwritten]</u>
<b>Topics:</b> <u>[Handwritten]</u>	<b>QC/Leader:</b> <u>[Handwritten]</u>

Instructions:

P2 R

[Faint handwritten notes and calculations, including numbers like 1.02, 1.03, and various symbols]



GROUP NAME: <u>U. A. P. A. 101</u> Logo:	Student Names (First and Last) Speaker/Presenter: <u>Natalie Cordeiro</u>
Date: <u>11/17/11</u> Topics:	Writer/Prep: <u>NA</u> QC/Leader: <u>Harmon</u>

Instructions: **(P3) F**

$\log_2(8) = 3$   
 $\log_2(16) = 4$   
 $\log_2(32) = 5$   
 $\log_2(64) = 6$   
 $\log_2(128) = 7$   
 $\log_2(256) = 8$   
 $\log_2(512) = 9$   
 $\log_2(1024) = 10$   
 $\log_2(2048) = 11$   
 $\log_2(4096) = 12$   
 $\log_2(8192) = 13$   
 $\log_2(16384) = 14$   
 $\log_2(32768) = 15$   
 $\log_2(65536) = 16$   
 $\log_2(131072) = 17$   
 $\log_2(262144) = 18$   
 $\log_2(524288) = 19$   
 $\log_2(1048576) = 20$   
 $\log_2(2097152) = 21$   
 $\log_2(4194304) = 22$   
 $\log_2(8388608) = 23$   
 $\log_2(16777216) = 24$   
 $\log_2(33554432) = 25$   
 $\log_2(67108864) = 26$   
 $\log_2(134217728) = 27$   
 $\log_2(268435456) = 28$   
 $\log_2(536870912) = 29$   
 $\log_2(1073741824) = 30$   
 $\log_2(2147483648) = 31$   
 $\log_2(4294967296) = 32$   
 $\log_2(8589934592) = 33$   
 $\log_2(17179869184) = 34$   
 $\log_2(34359738368) = 35$   
 $\log_2(68719476736) = 36$   
 $\log_2(137438953472) = 37$   
 $\log_2(274877906944) = 38$   
 $\log_2(549755813888) = 39$   
 $\log_2(1099511627776) = 40$   
 $\log_2(2199023255552) = 41$   
 $\log_2(4398046511104) = 42$   
 $\log_2(8796093022208) = 43$   
 $\log_2(17592186044416) = 44$   
 $\log_2(35184372088832) = 45$   
 $\log_2(70368744177664) = 46$   
 $\log_2(140737488355328) = 47$   
 $\log_2(281474976710656) = 48$   
 $\log_2(562949953421312) = 49$   
 $\log_2(1125899906842624) = 50$   
 $\log_2(2251799813685248) = 51$   
 $\log_2(4503599627370496) = 52$   
 $\log_2(9007199254740992) = 53$   
 $\log_2(18014398509481984) = 54$   
 $\log_2(36028797018963968) = 55$   
 $\log_2(72057594037927936) = 56$   
 $\log_2(144115188075855872) = 57$   
 $\log_2(288230376151711744) = 58$   
 $\log_2(576460752303423488) = 59$   
 $\log_2(1152921504606846976) = 60$   
 $\log_2(2305843009213693952) = 61$   
 $\log_2(4611686018427387904) = 62$   
 $\log_2(9223372036854775808) = 63$   
 $\log_2(18446744073709551616) = 64$   
 $\log_2(36893488147419103232) = 65$   
 $\log_2(73786976294838206464) = 66$   
 $\log_2(147573952589676412928) = 67$   
 $\log_2(295147905179352825856) = 68$   
 $\log_2(590295810358705651712) = 69$   
 $\log_2(1180591620717411303424) = 70$   
 $\log_2(2361183241434822606848) = 71$   
 $\log_2(4722366482869645213696) = 72$   
 $\log_2(9444732965739290427392) = 73$   
 $\log_2(18889465931478580854784) = 74$   
 $\log_2(37778931862957161709568) = 75$   
 $\log_2(75557863725914323419136) = 76$   
 $\log_2(151115727451828646838272) = 77$   
 $\log_2(302231454903657293676544) = 78$   
 $\log_2(604462909807314587353088) = 79$   
 $\log_2(1208925819614629174706176) = 80$   
 $\log_2(2417851639229258349412352) = 81$   
 $\log_2(4835703278458516698824704) = 82$   
 $\log_2(9671406556917033397649408) = 83$   
 $\log_2(19342813113834066795298816) = 84$   
 $\log_2(38685626227668133590597632) = 85$   
 $\log_2(77371252455336267181195264) = 86$   
 $\log_2(154742504910672534362390528) = 87$   
 $\log_2(309485009821345068724781056) = 88$   
 $\log_2(618970019642690137449562112) = 89$   
 $\log_2(1237940039285380274899124224) = 90$   
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 $\log_2(4951760157141521099596496896) = 92$   
 $\log_2(9903520314283042199192993792) = 93$   
 $\log_2(19807040628566084398385987584) = 94$   
 $\log_2(39614081257132168796771975168) = 95$   
 $\log_2(79228162514264337593543950336) = 96$   
 $\log_2(158456325028528675187087900672) = 97$   
 $\log_2(316912650057057350374175801344) = 98$   
 $\log_2(633825300114114700748351602688) = 99$   
 $\log_2(1267650600228229401496703205376) = 100$

GROUP NAME:	Student Names (First and Last)
Logo:	Speaker/Presenter: <u>Scott</u>
Date: _____	Writer/Prep: <u>Mengli Guo</u>
Topics:	QC/Leader: <u>Rex</u>

Instructions:

P3 R

"Ladder" Property  $n \log_b x = \log_b x^n$

$$\log_2 8^{1000} = 1000 \log_2 8 = 1000 \log_2 (2^3) = 1000 \times 3 = 3000$$

GROUP NAME:	Student Names (First and Last)
Logo:	Speaker/Presenter: <u>Stan Kaplan</u>
Date: _____	Writer/Prep: <u>Vaughn Brien</u>
Topics:	QC/Leader: <u>Danyan Zhou</u>

Instructions: P4 F

change the base

$$\log_b x = \frac{\log_a x}{\log_a b}$$

$$\log_b a = \frac{\log_c a}{\log_c b}$$

old base / new base

evaluate a old bases in terms of a new one

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ex: find  $\log_2 4 = \frac{\log_{10} 4}{\log_{10} 2} = 1.261857557$

ex: graph  $y = \log_2 x$



GROUP NAME:	Student Names (First and Last)
Logo:	Speaker/Presenter: <u>Tatiana O.</u>
Date: _____	Writer/Prep: <u>Dominique</u>
Topics:	QC/Leader: <u>Trey M</u>

Instructions:

P4 R

## 4. CHANGE OF BASE

$$\log_b x = \frac{\log_a x}{\log_a b}$$

Reverse: Divide logs of same base to get single log

Ex. Simplify  $\ln x / \ln 10 = \underline{\log(x)}$

GROUP NAME:

Student Names (First and Last)

Logo:

Speaker/Presenter: Arik Khanna

Date: \_\_\_\_\_

Writer/Prep: Onur Turkan

Topics:

QC/Leader: Shanoy

Instructions:

(PS) F



$x = y$  if  $\log_b x = \log_b y$

Take log of both sides

$\ln y = x$

$\frac{\log_A X}{\log_A B} = \log_B (X)$

$\log_B X = Y$

$B^Y = X$

$\ln(\log_A B^Y) = \ln(\log_A X)$   
(P3)

$\cancel{Y} \log_A B = \log_A X$   
(A)

$\cancel{Y} = \frac{\log_A X}{\log_A B}$

GROUP NAME:	Student Names (First and Last)
Logo:	Speaker/Presenter: <u>Onur Turkan</u>
Date: <u>10/7/13</u>	Writer/Prep: <u>Avik Khareja</u>
Topics:	QC/Leader: _____

Instructions:

PS R

$$\log x = \log 4 \text{ find } x$$

$$x = y \text{ if } \log_b x = \log_b y$$

$$\log x = \log 4 \text{ find } x$$

$$\underline{\underline{x = 4}}$$